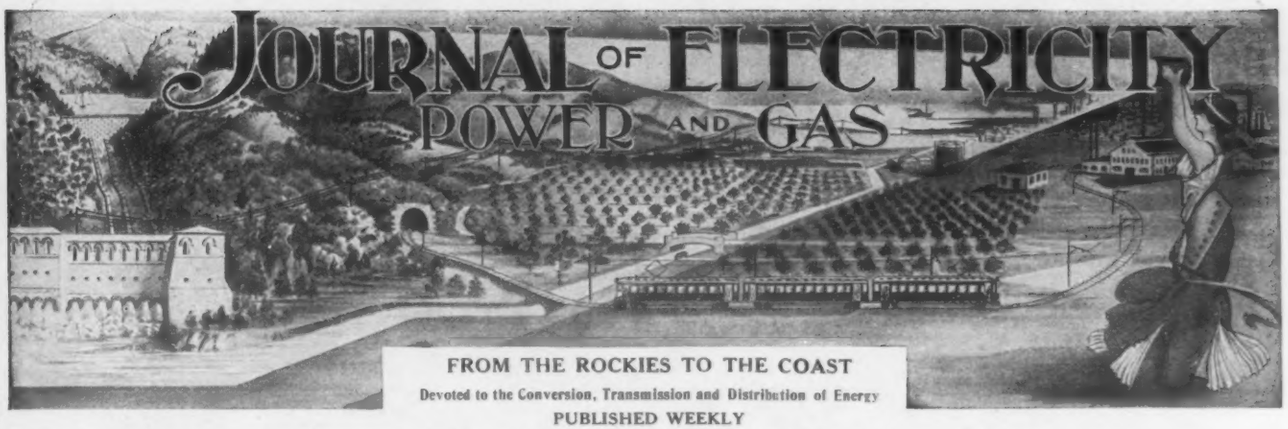
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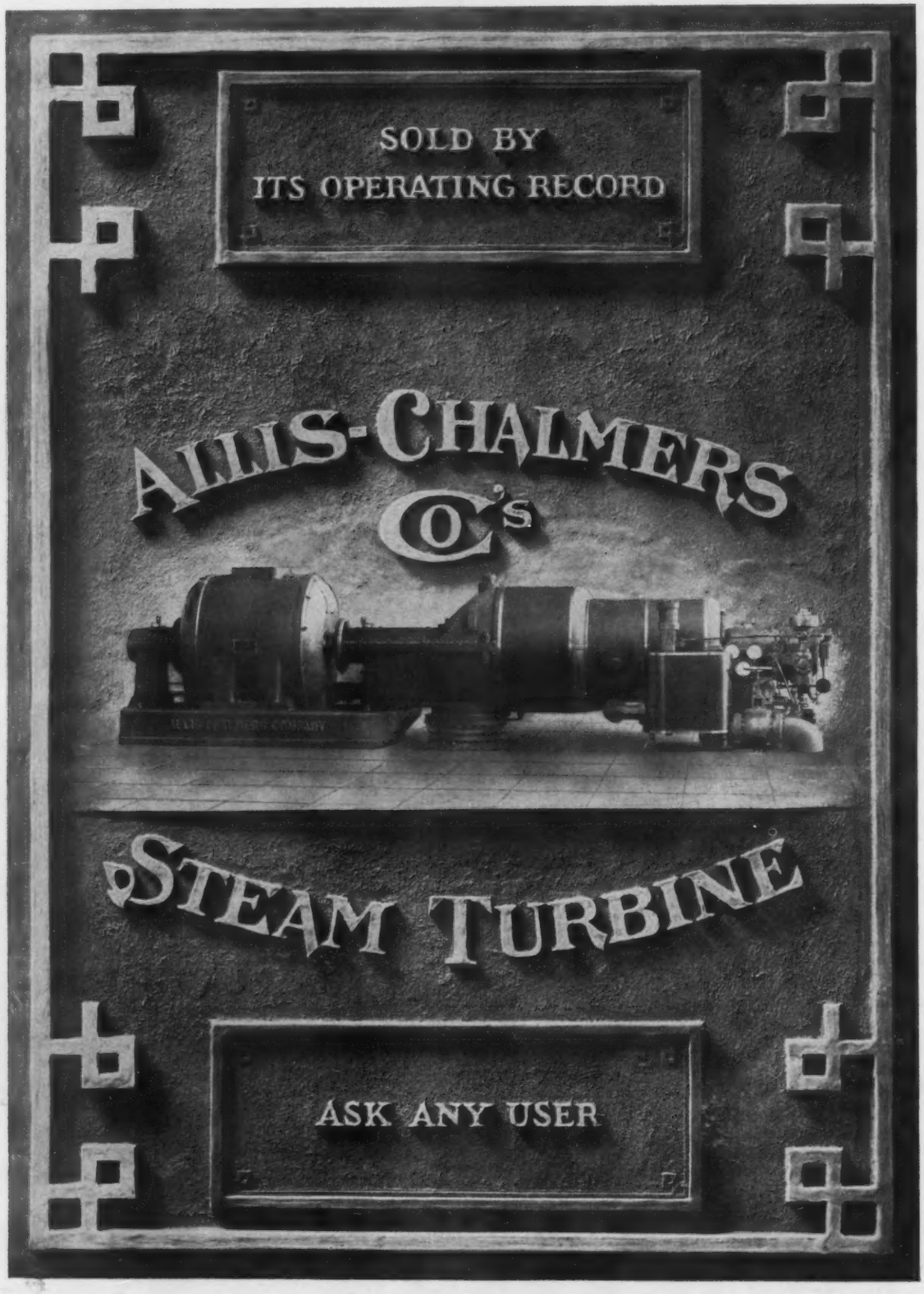

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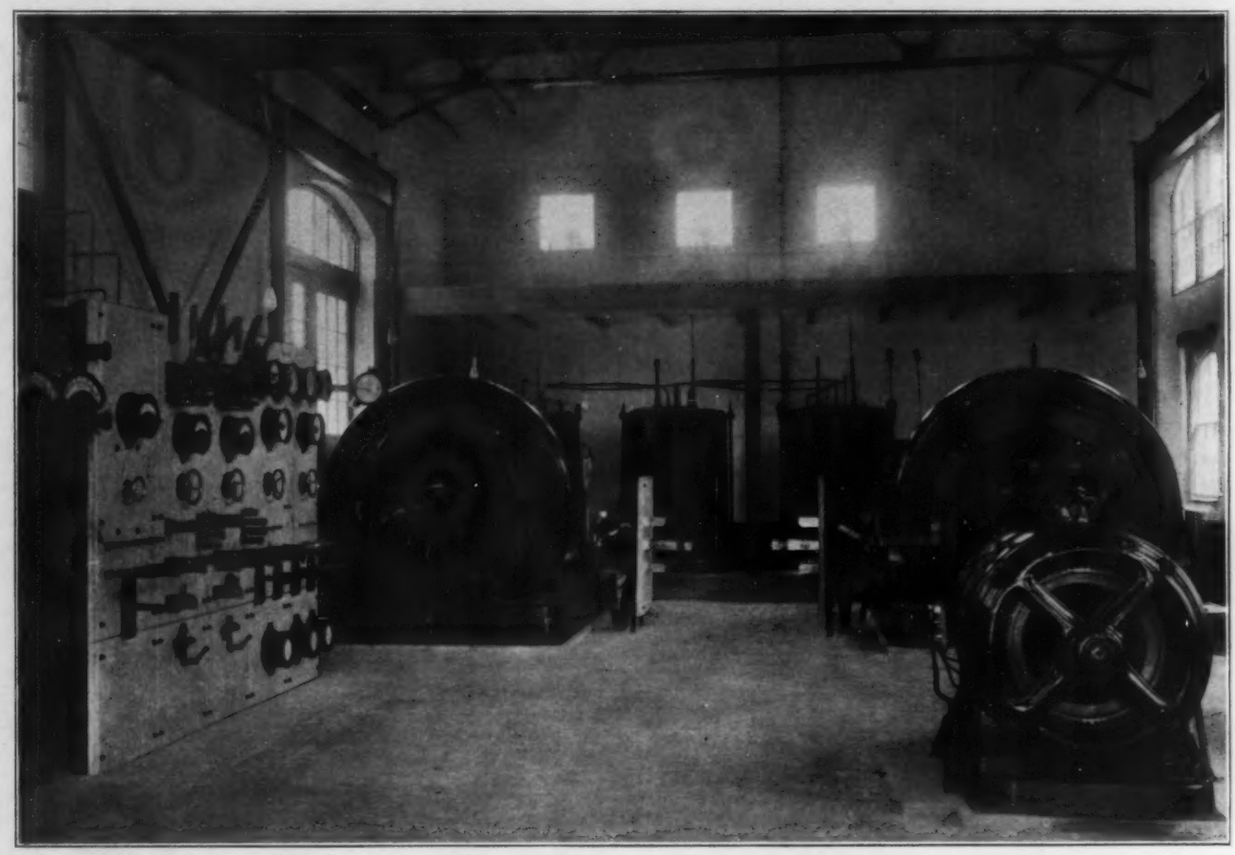
VOLUME XXI. SAN FRANCISCO, CAL., AUGUST 15, 1908 No. 7

THE SAN ANSELMO SUB-STATION OF THE NORTHWESTERN PACIFIC R. R. CO.

By R. B. ELDER

The installation of the "third rail" equipment by the North Shore Railway Company has been described in careful detail in these columns of many issues ago.* This system is now part of the Northwestern Pacific R. R. Co. and is operated in connection with their steam lines. The electric traction service, it may be said, starts at Sausalito on San Francisco Bay and is operated to Mill Valley, to Fairfax, and to San Rafael. The longest single run is thirteen miles.

It is contemplated to extend the road twenty miles to Point Reyes. To satisfy the present increased needs of the service and at the same time take care of the demands of the prospective twenty-mile extension has been the problem of the engineer in designing the San Anselmo sub-station. As before mentioned, the established system is operated at 600 volts and will so continue to be; the Point Reyes extension will be operated at 1200 volts. Provision is to be made so that by proper combination of motor units the trains may be run on either the 600-volt service of the present system or the 1200 volts of the Point Reyes division.



INTERIOR OF SAN ANSELMO SUB-STATION.

The current is generated at the company's own power house at Alto or is supplied from the transmission circuits of the California Gas and Electric Corporation, operating at a potential of 54,000 volts, three phase, sixty cycles. The road equipment is direct current, 500 to 600 volts potential. During the year 1904 an auxiliary station was established at San Anselmo and served its purpose to the present time, when the increase of traffic demanded larger and different equipment.

The new sub-station installation consist of two 500-kilowatt, revolving field, synchronous motor-generator sets, excited by a 30-kilowatt induction motor-generator set, switchboard equipment, and three 500-kilowatt, 54,000-volt, oil insulated, water cooled, lowering transformers. All of this apparatus was manufactured by the Allis-Chalmers Company and is of their latest design.

*Journal of Electricity, Power and Gas, January, 1904.

An interesting departure from ordinary practice is the method of excitation adopted with a view to making the regulation as nearly automatic as possible and reduce to a minimum reactive line disturbance in the transmission circuits of the power company.

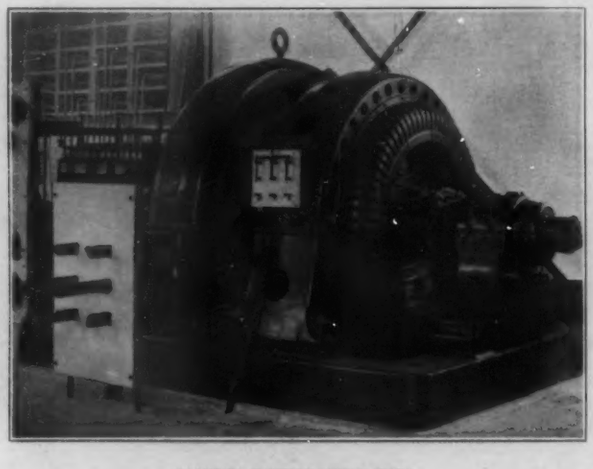
The exciter set generates at 600 volts and the synchronous motor fields are likewise wound for the same potential, so that exciting current may be taken in emergency cases from the "third rail."

The exciter consists of a compound wound D. C. 30-kilowatt generator, having the following characteristics: The shunt field winding and regulating rheostat are so proportioned that the shunt field alone will give the full exciting voltage at full load, but the exciter usually operates to produce sixty per cent of the full load voltage required for the full excitation of the synchronous motors with no load on their D. C. generators. The series field of the exciter is designed to carry a sufficient proportion of the total output of the station to over-excite the synchronous motor fields twenty per cent at full load output of the station. The feeder from the station at present comprises three cables. The series winding of the exciter is cut into but one of these cables and the amperage very nicely controlled by a shunt at the exciter. Thus it will be seen that as the load or output of the station increases the exciting voltage is automatically increased. The motor-generator exciter is of the two-bearing type, the induction motor operating at 850 revolutions per minute at 2200 volts and being started in the usual manner. This single exciter supplies field current for both the motor generator sets.

It will be noted that while the combined normal capacity of the motor-generator sets is 1000 kilowatts, there has been supplied 1500 kilowatt capacity in lowering transformers. This is to provide for two additional motor-generator sets when the Point Reyes extension is built. These later sets will have the same characteristics as the present 500-kilowatt sets and will operate two in series, thus delivering to that portion of the system intended 1200 volts. The switching equipment is such that any two machines may be operated in series, and with this end in view special insulation in the windings has been provided.

The motor-generator sets consist of a 500-kilowatt, direct-current generator with synchronous motor, having common base, shaft and two bearings, making a compact unit occupying a minimum floor space. The synchronous speed of the unit is 600 revolutions per minute, and it is started from the direct-current end in the usual manner by graduated insertion of armature resistance, the starting current being taken through the third rail from the "Alto" plant.

The synchronous motor is wound for 2200 volts, three phase, sixty cycles, and is of sufficient capacity to drive its generator at fifty per cent overload for at least two hours, with a rise in temperature of the windings of not exceeding 55° C. above the temperature of the surrounding atmosphere referred to 25° C. The pole pieces are easily removable, allowing convenient access to the stator windings.



MOTOR GENERATOR SET.

TRANSFORMERS.

The generators are of the eight-pole class, wound for 600 volts at full load and compounded for 550 volts at no load. The commutation is such that they will operate at full load continuously without sparking or burning at the brushes or blackening of the commutator, and from no load to fifty per cent overload, no adjustment is necessary.

The 500 K. V. A. transformers are wound for 54,000 volts with taps for 36,000 and 45,000 volts. They are operated Star connected with the neutral grounded. The secondary potential is 2200 volts, delta connected. They are of the shell type construction with coils mounted in vertical position, insuring good circulation of oil through liberal ducts between coils. The windings are in thin coils, one turn per layer, giving a maximum surface exposed to the cooling effect of the circulating oil and effecting a minimum voltage between layers. The cases are cylindrically constructed of boiler iron, riveted and caulked. The insulation test was rigorous, consisting of applying 110,000 volts between high voltage and low voltage coils and case, and operating the transformers at twice normal voltage, or 108,000 volts, for twenty minutes.

The installation is a credit to the engineers of the Northwestern Pacific R. R. Co. and to the Allis-Chalmers Co., as expressing the best development in this type of sub-station apparatus, and it is of peculiar interest to the engineer who has problems in regulation and combination of units to solve.

WIRING OF BUILDINGS FOR TELEPHONE SERVICE.*

(Concluded.)

Hotels.

The entire telephone traffic at hotels generally is handled by a private exchange switch-board. This switch-board must be connected with practically every room in the hotel and with a telephone central office, the latter by a few trunk lines. The location of the telephone outlet in each room of a hotel may be determined readily; therefore, it always is possible to install permanent wiring at the outset for the entire telephone system. This distinguishes hotel wiring from office building wiring, since the permanent wiring in the latter must terminate at the hall terminal boxes.

In a degree, the wiring of a hotel for telephone purposes is similar to wiring it for electric lights; the difference is that for telephone service a separate pair of conductors must be carried to each telephone, while in electric light work, all lights may be connected in one way or another to a single source of current. The method of wiring best suited to the average hotel is this:

A riser cable is installed at a convenient point, and at each floor is properly connected by smaller cables to suitable floor distributing boxes. From the proper box a pair of twisted wires is run to each telephone in each room. More than one riser cable may be needed in a large hotel. As in office buildings, the economy of such a system will depend very largely upon the care exercised in choosing the location of the cable riser shafts and the floor distributing boxes. Their locations should be such that the length of conduit, wire and cable runs will be a minimum.

The first thing to do in preparing wiring plans for a hotel, is to decide upon the location of the private exchange switch-board. A good location is generally found in or close to the office. This, in most cases, brings the switch-board on the first floor, and in occasional cases on the second or third floors. All house lines, incoming and outgoing trunks from and to the central office and all lines to the private exchange switch-board shall end at the main distributing terminal. This terminal affords a means of cross-connection, so that any room line or trunk line may be connected as desired to a chosen circuit in the private exchange switch-board. It will be seen that in this way the number of wires between the private exchange switchboard and the main distributing terminal will be large, and to reduce cost to a minimum the distance between the main distributing terminal and the switchboard should be made as short as possible.

In hotels of moderate size, not exceeding 150 rooms, it is generally considered good practice to arrange for a main distributing terminal directly at the rear of, or close to, the private exchange switch-board. Where this is not advisable and in the larger hotels, the main distributing terminal should be located in a separate room. This room, in the larger hotels, will also be required to care for certain power apparatus and other telephone accessories in addition to the wiring.

Where the switch-board is located on the first floor, an ideal location for the terminal room is directly below it in the basement. Where the private exchange is not located on the first floor, the terminal room, from the cost view-point, should be located on the same floor as the switch-board. This is not always possible, however, and in such cases, considering all things, the basement often is still the best place.

Where a separate room (or a room used in conjunction with electric fuse cut-outs, etc.), is to accommodate the main distributing terminal, a cabinet is not necessary. If the terminal must be located in a hall or other room, or at the back of the switch-board so as to be exposed to general view, a cabinet should be provided. This cabinet should be approximately one foot deep in the clear, and of the following height and width:

Number of pairs wires to switch-board, both trunk and local lines.	Height.	Width.
100 or less	4 ft.	2 ft. 4 in.
200	4 ft.	4 ft. 8 in.
300	5 ft. 4 in.	4 ft. 8 in.
400	6 ft. 8 in.	4 ft. 8 in.
600	5 ft. 4 in.	8 ft.
800	6 ft. 8 in.	8 ft.

The entire front of the cabinet should be fitted with removable doors. The design of the cabinet should harmonize with its surroundings.

Floor space of the following dimensions should be arranged for, where a separate room is provided for the main telephone terminal, or where space is to be allowed for it in other rooms. The following figures also allow room for the customary power and other special apparatus:

Number of pairs of wires to switch-board.	Floor space.
400 or less	9 ft. x 6 ft. 6 in.
600	9 ft. x 7 ft. 10 in.
800	9 ft. x 9 ft. 2 in.

In the telephone room or adjacent to the terminal cabinet there should always be provided two ordinary electric light outlets, fitted for Edison plugs, one for a portable incandescent lamp and the other for an electric soldering iron. Provision for these outlets will materially facilitate the work around the rack, and will do away with the necessity of ordinary soldering coppers and gasoline torches.

Provision always should be made to carry the incoming wires from the point where they enter the building to the distributing cabinet. A two-inch conduit generally will suffice for this purpose.

If ordinary wall telephone sets are to be used in rooms, the telephone outlet, consisting of an ordinary conduit outlet box, should be placed four feet ten inches above the floor. If sets mounted flush with the wall are to be used, a special conduit outlet box is required. Information concerning this outlet box should be obtained from the telephone company whose sets are to be used.

Portable desk stands are becoming quite common in hotel service; where these are used the outlet in most cases can be located with advantage in the base-board. This location, and the outlet box required, must be considered special, and should be given such consideration in each case.

It is often desirable to arrange that telephone service may be given in dining rooms and grills, from part or all of the tables. Such provision requires the use of floor or wall outlet boxes and special apparatus, the location of which may best be decided upon after a conference on the subject.

The individual outlet boxes on each floor should be connected by conduit runs to the floor distributing box or boxes, precisely as electric light outlets are connected to the floor cut-out boxes. One conduit run may serve a number of outlets, providing the locations of the outlets are in the same general direction. The size of conduit required is determined by the number of wires to be carried, and can be obtained from the table given later herein.

The floor distributing boxes should be placed so as to serve not more than twelve to fourteen rooms. By so placing the boxes, the length of the conduit runs to the individual outlets is reduced. These boxes may be placed in the halls or concealed in closets or otherwise treated as though they were cut-out cabinets for electric lights. A box seven inches wide, one foot three inches long, and two and one-half inches deep will accommodate a fifteen-pair distributing cable and associated terminal, which is sufficient to care for twelve to fourteen rooms.

*Abstract of bulletin published by the Home Telephone Co., of San Francisco.

As will be noted, the distributing cable allows for one or more extra pairs. These pairs should be provided always at each floor distributing box for private teelphones for guests and for other special purposes.

Should it be impracticable to reduce the number of rooms served from one box to twelve or fourteen, a larger distributing box must be constructed. A box one foot three inches long, one foot one inch wide, and two and one-half inches deep will accommodate a thirty-pair distributing cable and terminal. This is sufficient to care for approximately twenty-four to twenty-eight rooms.

While it is not generally necessary to connect the floor distributing boxes to the hall mouldings, it is, nevertheless, advisable to do so when it can be done at small cost. This provision often will be found extremely useful in running wires for special telephones and similar purposes.

As previously recommended for office buildings, riser cable shafts preferably should be located as to reduce the length of distributing cable to distributing boxes to a minimum. In all large hotels, more than one riser cable is generally advisable. In "L," "U," and "E" shaped buildings, separate risers in each wing will generally prove economical. The general requirements previously set forth for cable shafts in office buildings, as to their accessibility, location and equipment, apply equally well to similar shafts in hotels. The size of shafts, however, in hotels may be materially less than in office buildings. Where the size of the riser cable does not exceed 200 pairs of wires, a shaft three inches by six inches in the clear is ample for hotel telephone purposes. Where the size of the riser cable is greater than 200 pairs, the shaft should have a clear inside dimension of at least five inches by six inches. Such a shaft may be placed with advantage in a closet or elsewhere where its location will not be unsightly.

Access must be had to the shaft at each floor. The length of the opening should at least be four feet. From this opening, on each floor, conduit should be run to each of the distributing boxes on that floor. One conduit may serve more than one box where the location of the boxes permit. The size of the conduit is determined by the size and number of cables.

Where the main distributing terminal is located in the basement, the riser shaft should extend to the basement if possible. If the shaft does not extend to the basement, it should be extended to the main terminal by conduit runs, the size of conduit depending upon the size and number of the cables.

Where the main terminal is located on the second or third floor, the shafts should be connected to the main terminal by conduit runs in such a manner as to reduce the length of cable to a minimum.

The flexibility of a shaft accessible at each floor is a distinct advantage when placing the riser cable or when connecting it to the distributing cables as hereinafter described.

Such construction, however, is not always possible, due to very narrow partitions, etc. Where this condition is met, conduit generally can best be used. The use of conduit requires special connection boxes at each floor where the riser cable is to be spliced to the distributing cables.

Where a connection box is located on each floor, the distributing boxes on that floor may be connected to it by conduit as described above. In many cases, however, connection boxes may not be placed on each floor, but on each fourth or fifth floor. In these cases several distributing conduits may be required.

The requirements of this class of construction vary in almost every case; for this reason, we recommend that where riser conduits are necessary, that the details of junction boxes. size of conduit, etc., be decided upon after a conference on the subject.

From the individual outlet or outlets in each room, there should be run to the proper floor distributing box a twisted pair of No. 19 B. & S. gauge, braided, rubber-covered, tinned, soft copper wire. This wire must be of the best quality, as good wire is essential to good telephone service. Specifications for a satisfactory wire are given later.

Where a separate circuit is run to each outlet (the usual case), a third or ground wire is not necessary unless coin-prepayment or other special service is desired; in the latter case, a third wire tap, of the size and quality above specified, should be brought out at each outlet. The third wire taps from all outlets should be spliced to a common ground wire at the distributing box or other convenient point. For mechanical reasons, this common ground wire should not be smaller than No. 12 B. & S. gauge, and should be of the best quality of braided, rubber-covered, tinned, soft copper wire.

At each floor distributing box, the wires from the various outlets should be connected to the distributing cable, preferably by means of suitable binding posts mounted on strips of suitable insulating material.

The distributing cables from the riser cable shafts should be lead covered, and should consist of a number of twisted pairs of No. 22 B. & S. gauge, double silk and cotton insulated, soft, tinned copper wires.

The size of the distributing cable is determined by the number of outlets it is to serve. As before stated, an extra pair or so should be allowed where possible. This will naturally follow where a fifteen-pair cable serves from twelve to fourteen rooms.

Even where one conduit serves more than one distributing box, only one cable should be placed in a conduit where practicable. This may be done in most cases by tapering the cable at each box so that only the wires actually required will be carried ahead.

At the riser cable shaft or shafts, the distributing cables should be permanently spliced to the riser cable or cables as the case may be.

The capacity of the riser cable or cables generally should be made to equal the combined capacity of the distributing cables, unless there are an unusually large number of dead wires in the latter. In case the number of dead wires is large, the capacity of the riser cable or cables may be decreased as required and certain of the dead wires in the distributing cables on each of the floors connected to the same conductors in the riser cable, or left dead if desirable.

In hotels of not over five or six stories, the riser cable should preferably be of the same kind as the distributing cables; namely, lead covered, with No. 22 B. & S. gauge, double silk and cotton insulated wires. The distributing cables then may be spliced to the riser cables at each floor. To make a splice, remove the lead sheath for a foot or so; dip the exposed conductors in hot beeswax (hot enough to run freely, but not so hot as to burn itself or to scorch dry paper), and after removing a little of the insulation, twist the wires of the distributing cable tightly around the corresponding wires in the riser cable. The joints so made should be well soldered with flux solder (no acid), and then well and uniformly insulated by narrow strips of the best quality of tape; after this the whole splice should be sewed up and taped, the tape being given three wraps to its width. The completed splice should then be thoroughly shellacked with good grain alcohol shellac. It is essential that all strain should be removed from the completed splice. This can be done best by securely strapping the cable to the wall directly above and below the splice. In making the splice, care must be taken not to let moisture get into it.

In the larger hotels, especially where a large number of rooms are to be served on each floor, the first cost can be materially reduced by using lead-covered cables with paper-insulated conductors, such as used by the telephone company in its underground conduits. Where this type of riser cable is used, it is better to make one splice to the distributing cables at every fourth or fifth floor, thus paralleling certain of the distributing cables for a floor or so, rather than to splice the distributing cable to the riser cable at each floor. The reason for this is that splices to paper cables are expensive

to make and must be made with great care, since the paper insulation of the conductors will not stand rough usage or exposure to moisture. To make the splice moisture proof, it is customary to cover it with a lead sleeve wiped (soldered) at each end to the lead sheaths of the spliced cables. Splices of this nature should be made only by experienced cable splicers. It is suggested that where such splices are to be made, the subject be referred to the telephone company for advice.

It now remains to convey the riser cables to the main distributing terminal. This can be done easily where the preceding suggestions have been followed. Where silk and cotton cables have been placed very close to the centers of distribution, at which points the floor distributing boxes are located.

It should be noted that the arrangement adopted permits the use of a considerable quantity of common conduit; that is, a conduit accommodating more than one pair of wires. The location of these common conduits is indicated on the diagram by wire-runs lengthwise in the corridors.

Apartment Houses.

The following notes refer in particular to those apartment houses which are of sufficient size (or of such a type) as to warrant a private exchange. It may be said that the

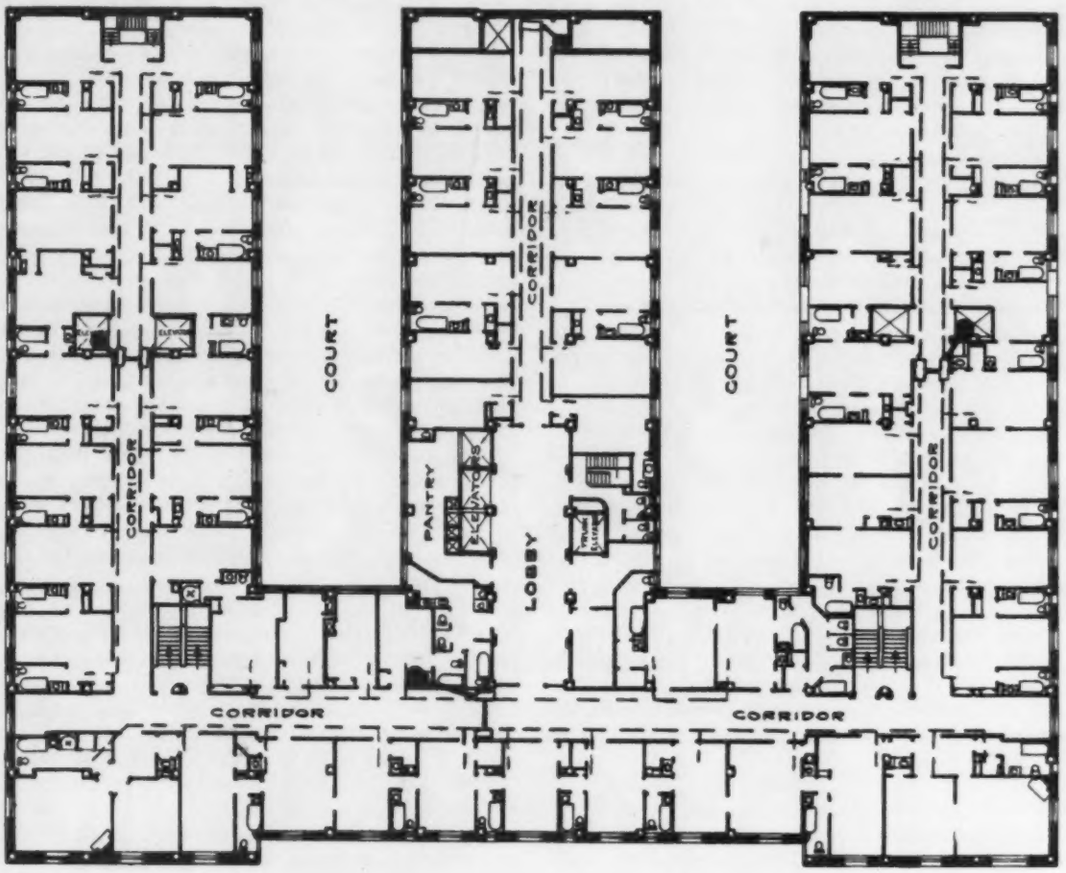


FIG.6

HOTEL

riser cables are employed, they may be attached directly to the terminal strips on the main terminal rack, the exposed insulation first being dipped in hot beeswax. Where paper insulated cables are used, the cable must be "potheaded" before being attached to the terminals, unless combined cable heads and terminals are used. For further information regarding this subject, the interested party is referred to the telephone company. The making of potheads requires a certain special skill.

Figure 6 illustrates an actual example of the method of wiring described in these paragraphs. In this particular case, four riser cables were employed, two being run up elevator shafts and the other two in small shafts constructed expressly for telephone purposes.

The instance cited is exceptional with regard to the economy of distributing cable, and is due to the fact that the riser requirements of this class of apartment houses, with regard to telephone service, are similar to the requirements of hotels.

In apartment houses, one telephone generally is required for each apartment. This makes the ratio of telephones to rooms considerably less than in hotels. It is for this reason that the method of wiring best suited for hotels is not generally the most economical or the best suited for apartment houses, except in cases of very large buildings, or where the arrangement of the apartments on each floor is irregular.

In most apartment houses, the apartments on the several floors are arranged in a similar manner. Should the telephones in each vertical tier of apartments be located in the same relative position, it will be seen that one vertical riser conduit running from the basement to the top floor can be made to serve all telephones in each tier of apartments, and

in many cases, one conduit can be made to serve *more* than one tier of apartments. Where this method of wiring can be applied, it will generally be found to be the most economical and desirable.

Most of that part of the preceding chapter on hotels, relating to the location of the private exchange switch-board and the main distributing terminal in hotels, applies equally well to the location of these items in large apartment houses.

Care should be taken not to overlook the conduit that may be required between the main distributing terminal and the private exchange switch-board. The size of this conduit will depend upon the size of the cable it is to accommodate. Where possible, the conduit also should be run from the main distributing terminal to the point at which the service wires from the telephone company will enter. A two-inch conduit generally is sufficient for this purpose. The location of the point at which the service wires of this company should enter the building, will be given upon request.

To permit the use of the system above described, it is essential that there be an outlet in each apartment of each vertical tier, in line with the common vertical riser conduit. In most cases, the telephone may be located at this outlet. Should another location be desirable in certain apartments, an additional outlet box should be installed at the desired location and connected to the outlet box referred to above by a suitable run of conduit.

Whether the outlet box is to be of standard or special design such as required for flush sets, or whether it is to be located for a wall set, or a portable set, will depend upon the type of instrument desired. This point has been discussed fully in the preceding chapter on hotels.

The size of each of the vertical riser conduits is determined by the number of wires it is to accommodate, and may be obtained from the table. The size of these conduits may be tapered from floor to floor as the number of wires to be carried by the conduit decreases. All riser conduits should be carried to the main distributing terminal.

The type of main distributing terminal best suited to most apartment houses, is one which mounts in a cabinet. The size of the terminal cabinet is determined by the number of apartments the terminal is to serve, and should be of the dimensions given in the preceding chapter for similar cabinets in hotels.

The telephone outlet in each apartment should be connected to the main distributing terminal by a twisted pair of No. 19 B. & S. gauge, rubber-covered wires, which wires may be fished easily through the conduit after the latter has been installed. In some of the larger apartments, it will be found economical to splice the individual wires, at the bottom of each vertical conduit, to a lead-covered cable containing a proper number of No. 22 B. & S. gauge double silk and cotton insulated wires, thus conveying the circuits from the splice to the main distributing terminal in the cable.

Cable similar to that referred to above, should be used to connect the main distributing terminal to the private exchange switch-board.

Figure 7 of this article illustrates the wiring of a typical apartment house. In this case, a number of risers have been located so as to serve more than one apartment each.

Flats.

Small apartment houses—and sometimes certain large ones—may be considered to be flats, from a telephone standpoint, in that both classes of buildings do not as a rule require private exchanges. It may be said further that intercommunication between such apartments or flats, generally is not necessary, and sometimes is undesirable. For convenience, all buildings in the above classes will be referred to as flats.

It is not intended that the following should be taken as a recommendation to wire all classes of buildings in advance for telephone service, for there exist such differences in grades of flats that the wiring justified for one building might not be justified for another. For the less elaborate grades of flats, where appearance is not of the greatest moment, little is to be gained in wiring a building for telephone service. Therefore, the following paragraphs must be taken as applying to the better class of buildings, where appearances would warrant the small expense of installing a few wires.

Unless local service to the vestibule or janitor is required (about which a word later), the problem resolves itself into a very simple one, merely that of running a couple of twisted pairs of wires to each flat from some common distributing point, bringing out a common ground wire tap at each flat, and making provision to carry the entering service wires to the distributing points.

The location of each telephone outlet (one for each telephone company) having been determined, there should be run to each outlet from the predetermined common distributing point, a pair of No. 19 B. & S. gauge, braided, rubber-covered, copper wires, and a single tap of the same kind of wire connected to a common ground wire of braided, rubber-covered copper, not smaller than No. 12 B. & S. gauge, unless the individual tap for each flat can be more conveniently carried independently to the common distributing point, in which case the common ground wire may be omitted.

The common distributing point preferably should be located in the basement. Should the building be served by an underground system, further provision for wiring need not be made unless the basement walls are finished, in which case two conduits (one for each company) should be run through the finished portions of the basement, thus avoiding the necessity of carrying exposed wire or cable through a finished room. Should the building be served by an aerial lead, either at the front or at the rear of the building, two conduits should be run from the common distributing point to a point or points on the front or on the rear of the building, directly opposite the aerial leads from which the service wires or cables will be taken. By properly placing these conduits, one for each of the two companies, an unsightly group of widely-separated wires will be done away with. The practice as described is now generally followed in bringing in service wires for electric lights.

The location of the point which will permit the service wires or cables of this company to enter by the most direct, and therefore the best appearing route, can be obtained on request.

In comparatively small buildings of not over six or eight apartments, a distributing cabinet generally is not necessary. In larger buildings, however, a distributing cabinet for each company should be arranged for at the common distributing point. It should have a removable door, hinged or otherwise, and should be approximately six inches deep. Its length and width should be as follows:

No. of pairs wires	Length.	Width.
10 or less	1 ft. 10 in.	1 ft. 4 in.
20	1 ft. 10 in.	2 ft. 8 in.
40 or more	4 ft.	2 ft. 8 in.

When desired, special facilities for local service can be provided which will permit a caller in the vestibule to ring and speak with the occupant of any apartment or with the janitor. The occupant of each apartment also may call the janitor or be called by him. To provide for such a system, of course, will require some additional wiring and special apparatus. But such apparatus does away with the usual tin speaking tube and push button. Further information regarding these features will be furnished if wished.

Private Dwellings.

In the average private dwelling, not requiring a private exchange system, it is difficult to know in advance just where the telephones will need to be placed. For this reason, and since the few wires to be run can be concealed easily, it is not generally advisable to wire in advance for telephone service.

In the more pretentious dwellings, special telephone services are growing in use and are found of great value in the discharge of household and social duties. The use of telephones in such homes is so varied that a complete description may not be given here. We recommend consideration of the wide possibilities which offer themselves, and we are glad to help in every case which may arise.

Wiring in Conduit versus Other Methods of Wiring.

In the preceding chapters, with the exception of that on office buildings, wiring in conduit has been referred to exclusively. It should be said, however, that conduit in telephone work is no more necessary than in electric light work, but, as in electric light work, it is the best and safest way in which to carry permanent wiring. This statement does not refer to riser shafts in which lead-covered cables only are run. Where, for any reason, conduit is not employed, all wiring should be done in accordance with Section 64 of the Rules and Regulations of the National Board of Fire Underwriters for Class E work. The quality and size of the wire and cable should be the same as previously specified.

Where provision must be made for future wiring, except where shafts are used, or where the wiring is not to be installed until required, such as between the main distributing terminal and point at which the service cables or wires enter the building, conduit should be installed as specified herein.

Construction Material.

Experience has shown that weatherproof, annunciator and other similar wire not rubber covered, will not give satisfaction when used in buildings for telephone purposes. Below are given specifications for an approved, twisted pair, braided rubber insulated wire for telephone use, whether run in conduit or otherwise.

The wires should be of No. 19 B. & S. gauge, and should be of soft copper, well tinned. Each tinned-copper conductor should be evenly and smoothly covered with an approved rubber insulating compound of an outside diameter of not less than three thirty-seconds of an inch. The insulated covering should be flexible and not liable to deteriorate under ordinary conditions, nor to act injuriously on the conductor. Each insulated conductor should be covered with a close braid of cotton or other approved material. This should either be of polished cotton or treated with a paint or compound which will be insoluble in water and shall not act injuriously on the insulating compound. The braid on one wire should have a raised thread or an approved equivalent marker, so that the wires may be easily distinguishable from each other. The two insulated braided conductors constituting a pair shall be twisted together. The twists should be regular and uniform. The length of the twists should not be less than one and three-quarter inches nor more than two and one-half

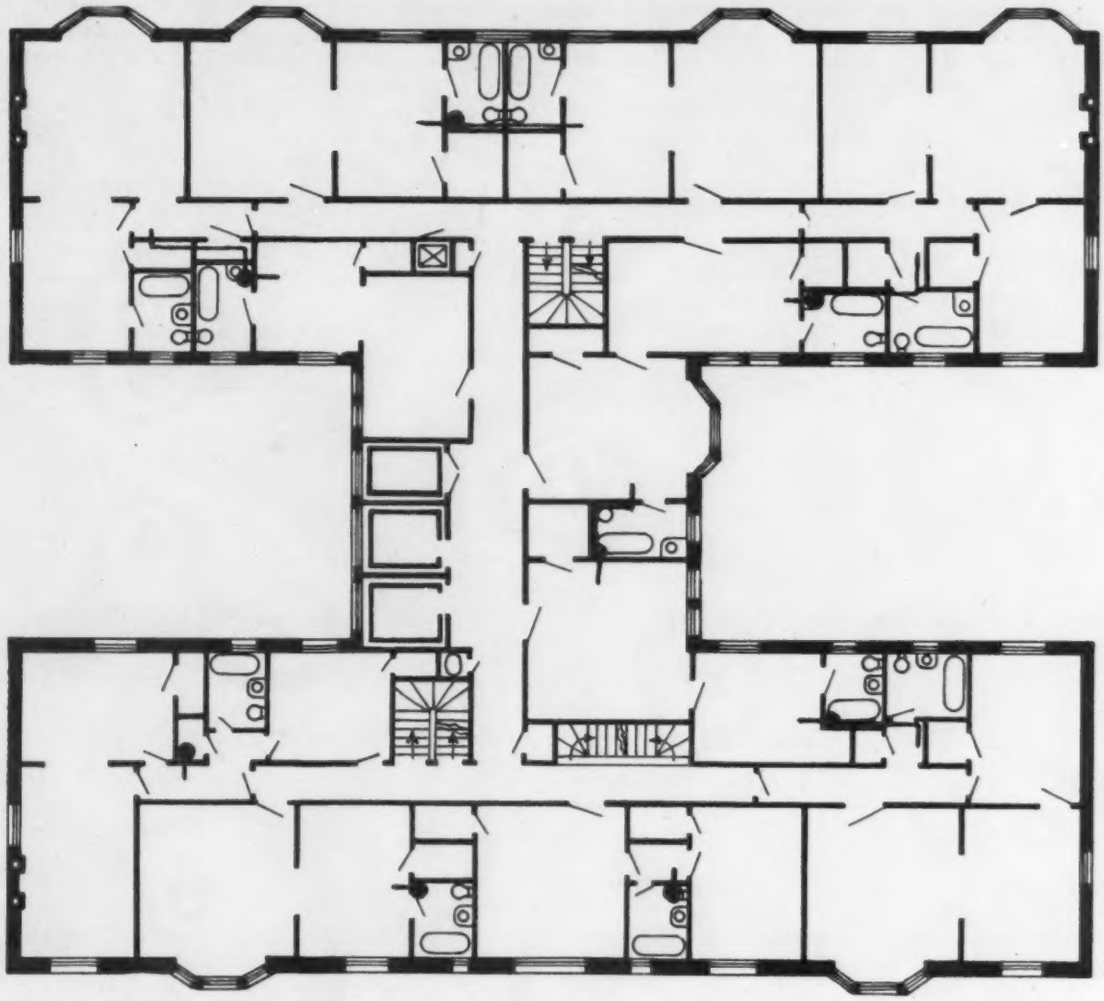


FIG. 7
APARTMENT HOUSE

inches. The completed wire should be capable of withstanding a pressure of one thousand volts alternating current, and should have an insulation resistance of at least two hundred megohms per mile at a temperature of approximately sixty-five degrees Fahrenheit. The resistance of each conwireatsixtydegreesFahrenheit. r hrdluaoir rdlu ductor should not exceed fifty ohms per mile of completed wire at sixty degrees Fahrenheit.

The approximate weights and dimensions of lead-covered cables for use in buildings, are as in the following table. The values may vary among manufacturers, but these are sufficiently correct to enable one to obtain a practical idea of what spaces must be provided to accommodate the various cables:

Lead-covered Cable with No. 22 B. & S. Gauge Paper Insulated Conductors.

Size	Outside diameter.	Thickness of lead sheath.	Weight per ft.	Maximum amount one one reel.
10 pairs	17/32 in.	1/12 in.	.647 lbs.	3000 ft.
15	19/32 in.	1/12 in.	.758 lbs.	3000 ft.
25	23/32 in.	1/12 in.	.963 lbs.	2500 ft.
50	15/16 in.	1/12 in.	1.356 lbs.	2000 ft.
100	1 1/ 4 in.	3/32 in.	2.15 lbs.	1500 ft.
150	1 17/32 in.	3/32 in.	2.81 lbs.	1250 ft.
200	1 3/ 4 in.	1/ 8 in.	4.108 lbs.	1000 ft.
300	2 1/16 in.	1/ 8 in.	5.14 lbs.	800 ft.
400	2 5/16 in.	1/ 8 in.	6.184 lbs.	700 ft.

The above cable has a mutual capacity of .069 microfarads per mile and an insulation resistance of 500 megohms per mile.

Lead Covered with No. 22 B. & S. Gauge Double Silk and Cotton Insulated Conductors.

Size.	Outside diameter.	Thickness of lead sheath.	Weight per ft.
5 pairs	3/8 in.	3/64 in.	.258 lbs.
10	7/16 in.	3/64 in.	.3425 lbs.
15	1/2 in.	3/64 in.	.42 lbs.
20	17/32 in.	3/64 in.	.456 lbs.
25	19/32 in.	3/64 in.	.532 lbs.
30	5/8 in.	3/64 in.	.571 lbs.
40	11/16 in.	3/64 in.	.676 lbs.
50	25/32 in.	1/16 in.	.953 lbs.
75	15/16 in.	1/16 in.	1.22 lbs.
100	1 1/16 in.	1/16 in.	1.49 lbs.
150	1 1/4 in.	1/16 in.	1.95 lbs.
200	1 7/16 in.	1/16 in.	2.52 lbs.
250	1 11/16 in.	1/16 in.	2.93 lbs.

Any approved forms of conduits and fittings may be used for telephone purposes. The size of conduit required for various numbers of pairs No. 19 B. & S. gauge braided rubber-covered wires is given in the following table. No conduit should contain more than three bends nor should it be more than one hundred feet in length, unless the conduit is entirely free from bends. Where a long conduit run with bends cannot be avoided, pulling boxes should be installed at the bends or the size of the conduit increased as required.

Maximum No. of pairs of wires in conduit.	Size of conduit for lengths up to 100 feet.	
	50 ft. or less	50 ft to 100 ft.
1	1/2 in.	1/2 in.
3	5/8 in.	3/4 in.
4	3/4 in.	1 in.
8	1 in.	1 1/4 in.
15	1 1/4 in.	1 1/2 in.
25	1 1/2 in.	1 3/4 in.

One No. 12 B. & S. gauge common ground wire should be considered equivalent to one pair of No. 19 B. & S. gauge wires.

The radius of bends in the above conduit, when accommodating wires only, should not be less than that given below.

Size of conduit.	Minimum radius of bend.
1/2 in.	5 1/2 in.
3/4 in.	6 3/8 in.
1 in.	7 in.
1 1/4 in.	7 3/8 in.
1 1/2 in.	9 1/2 in.
2 in.	10 3/4 in.
2 1/2 in.	11 1/2 in.
3 in.	14 3/4 in.

The radii above given are those used in standard loricated conduit elbows.

In the two following tables will be found the size of conduit required to accommodate lead-covered cable with No. 22 B. & S. gauge conductors. No conduit should contain more than three, one-quarter (ninety degree) bends, nor should it exceed one hundred feet in length, unless the conduit is entirely free from bends:

Size of Conduit Without Bends for Lead-covered Cable.

Maximum number of pairs in each cable.	Size of conduit for one to three cables.	
	1 cable.	2 & 3 cables.
15	1 in.	2 in.
25	1 in.	2 in.
50	1 1/4 in.	2 1/2 in.
100	1 1/2 in.	3 in.
150	2 in.	
200	2 1/2 in.	
300	2 1/2 in.	
400	3 in.	
600	3 1/2 in.	

Size of Conduit With Not More Than Three Bends. (One Cable Only Permissible in Conduit.)

Maximum number of pairs in each cable.	Size of conduit.
15	1 in.
25	1 1/4 in.
50	1 1/2 in.
100	2 in.
150	2 1/2 in.
200	2 1/2 in.
300	3 in.
400	3 1/2 in.

Where lead-covered cable is run in conduit, and bends are necessary, the bends must have an exceptionally large radius to permit the cable to be pulled readily without injury. The minimum radius recommended for one-quarter (ninety degree) bends in conduit containing cable, is as follows:

Size of conduit.	Radius of bend.
1 in.	10 in.
1 1/4 in.	12 in.
1 1/2 in.	15 in.
2 in.	18 in.
2 1/2 in.	24 in.
3 in.	30 in.
3 1/2 in.	36 in.

Soldering fluid of any kind should not be used in telephone work. A resin flux only should be used. Hollow core solder filled with resin flux can be obtained.

Where adhesive tape is used and particularly at splices, it should be of the best quality. A good tape should be but slightly hygroscopic and should have no action on copper. Its adhesiveness and durability should be lasting and its insulation resistance should not fall materially when exposed to moisture.

Where terminal strips or racks upon which they are to be mounted are desired, it is suggested that the telephone company be consulted as regards the type best suited to a particular case. The design of this apparatus varies materially with its manufacture, and for this reason a description of such apparatus is not possible herein.

ELECTRICAL PICNIC.

A secret session of coy contractors among the rocks and ferns of the beautiful Niles Canyon last Saturday was rudely invaded by a gang of jubilant jobbers, who, perforce, were invited to join in the pastime of driving dull care away. It is rumored that Wiggins, aided and abetted by Murman and Hanbridge betrayed the meeting place. One jobber was seen to pay some money to Wiggins and received in return therefor a certain green ticket. However, there is no receipt to prove this allegation, albeit in San Francisco neither the jangle of the telephone bell nor the frantic pounding on the jobber's door met with response. He had hiked to the tall timber in search of the bashful electrician. Armed with "smiles" and "thanks," each salesman selected his game and ere evening had bagged it.

Most of the contractors had arranged for their wives or sweethearts to furnish the lunch. The improvident jobber had to forage on the country. Someone caught a sheep that had once been young, which was made to serve as the "piece de resistance." After the inner man had been fortified for the strenuous exercises of the afternoon each chased his favorite phantom. The social lights found it in the whirl of the dance; the romantic wandered off among the trees and ferns, and the sporting element, disappointed in the baseball game, indulged in "crusoe."

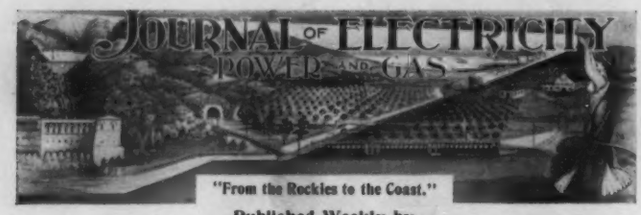
The ball game was the first contest in which the jobbers had planned to do up their friends. Scouts were sent in all directions to find a flat field. One lady had an electric flat-iron, but this was rejected on account of the great heat. A flat area was reported, but was found to slant at an angle of forty-five degrees, and so it was rejected. Hard search finally showed that the only thing flat within five miles was the beer. Several flies were caught on paper and a number of high-balls were downed.

But finally the gloves and masks were discarded for the fierce competition of a game of "crusoe." Several were started, the winners of the preliminary heats being scheduled to play a final, but as some played a five cent "ante" while others started with a fifty, the handicappers were unable to classify them, especially as each one claimed to have lost money.

Last but not least were the long-heralded foot races. Munificent prizes had been donated by the Western Electric Company, John R. Cole Company, Brooks-Follis Electric Company, Electric Appliance Company, Butte Engineering and Electric Company, Decker Electric Company, California Electric Construction Company, Central Electric Company, and the Century Electric Company.

Careful scrutiny showed that all electricians present could be divided into three classes: the lightweights, the heavyweights, and the ladies. Volunteer representatives from each class were eager to compete for the prizes offered. In the race for the lightweights, the first heat was won by Mellman, with Dunbar a close second; the second heat by Herbert, with Anderson second; and the third heat by Ayden, closely followed by Fagan. The juvenile final was handily won in a canter by Herbert, the second honor falling to Ayden. The race for the heavyweights created the greatest interest, the list of entries being heavy both in point of numbers and avoirdupois. In spite of local injunctions against gambling, several large purses were laid, Pop Boynton appearing to be favorite, although Aylesworth's popularity proved the undoing of several of his friends. The entries in the first heat were: H. G. Aylesworth, Philip Levy, E. L. Boynton, Sam Weidenthal, W. D. Pennycook. Contrary to expectations, Weidenthal waddled in first with Levy lumbering close behind and Boynton bringing third. Hanbridge was the only "also ran" in the second heat, John R. Cole and Paul Butte having tied for the first place and Chester Fayles claiming the second. As Cole "kept smiling," he was the logical winner of the final, Butte and Levy taking second and third honors at a gallop.

Again last, but far from least, came the ladies' races. Amidst thunderous applause Miss Erickson came in first in the first heat, Mrs. Booth and Miss Ogilvie coming in second and third. The second heat was skilfully won by Miss Miller, closely followed by Miss Levy and Mrs. Drendell in turn. Miss Miller proved the fastest of the bunch in the finals, while Miss Erickson and Mrs. Booth were not far behind for second and third places. This race was the one hardest fought of the day, and when Miss Miller drew away inch by inch from her competitors, the crowd, breathless until then, burst forth into mighty applause. It is claimed that it was nothing except Miss Miller's long eyelashes that gave her first place. So great was the disappointment among the losers that consolation rāces were run off for the benefit of the other ladies. Miss V. Bray and Miss Ogilvie, Jr., getting a place in the first and Miss Levy and Mrs. Drendell the coveted positions in the second. The only dissatisfaction expressed by those present was at the work of the handicappers, and as the form is now well known, the next meeting of these thoroughbred trotters will require the services of several expert bookmakers.



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In next week's issue will appear full details of the exhaustive tests recently concluded at the Redondo power plant of the Pacific Light & Power Co.

Standard Scientific Symbols.

The utility of a universal system of symbols representing engineering quantities is self evident. Numerous suggestions have been made, but none as yet have withstood the exacting break-down test of disruptive criticism. The latest proposal is embodied in a communication from Mr. Miles Walker, acting for a sub-committee of the British Electro-Technical Commission. Recognizing that the greater part of the problem is not so much notation as it is nomenclature, he suggests a number of new symbols pictorially representing the various physical quantities. Quoting from his letter:

"For instance ⌊ might represent temperature. If we were told that this simple outline of a thermometer represents temperature, we would have no difficulty in remembering it. Similarly, 𝒻 might represent Force, and the various "Forces" might be derived from it; for instance ϟ electromotive force, (conventional representation of lightning); ∩ magneto-motive force and ⌊ might indicate the degrees centigrade above the absolute zero. The name of the type might be the name of the physical unit which it represents; for instance for ϟ we might read "Volts."

While we agree that standardization with its concomitants of stability and precision is greatly to be desired, yet we cannot approve of the method suggested. In the first place, there are many abstract quantities whose concrete symbolical expression would require a great stretch of the imagination, not so much on the part of the man who suggests them, as in the mind of the engineer who must use them. In working with symbols it is a waste of time to have to form a mental picture of the thing represented. The picture of a candle might well suggest candlepower, and the picture of a clock, time; but to represent an acute angle by the figure of the jackal which the ancient Egyptians employed to show cunning, and therefore acuteness, would soon lead to the ridiculous. The dictionary of the Chinese language, which contains more than forty thousand monosyllabic characters, might furnish many other homologous signs. Here, indeed, is an ideal field for unchecked ingenuity in morphology, philology, or any other "ology." Ample warning should be given engineers that they will be required to forget all that they know, so as to learn their A B C out of a new primer. To the perplexities with which the printer is already surrounded would be added a new font of type, guaranteed to make any formula incomprehensible. As working models, we would suggest that the ambitious symbolizer obtain copies of the Rosetta and Moabite stones, for it is in the hieroglyphics of the ancients that we find the symbolic ideographic preceding the phonetic.

We do not envy any Commission attempting to devise a unique system of symbols acceptable alike to the physicist, the chemist, and the engineer. Specialization necessarily precedes generalization and standardization for the individual professions should precede any attempt at universal conformity. Again, to standardize by injecting a multitude of new signs into a list already

too complex by far, does not seem wise. The possibility for mistake increases in direct ratio to the number of figures to be handled.

Custom has already established a number of standard symbols for the English-speaking engineer, based upon the initial letter of the word which the symbol is supposed to represent. If English, German, and French engineers should not be willing to mutually agree on a composite system after due conference, it would seem far better to wait until some universal language upon which to base the standardization of scientific terms, is found.

THE ATTITUDE OF THE GOVERNMENT TOWARD WATER POWER DEVELOPMENT.

Correspondence.

The recent article by Mr. Baum on the protection and development of water power development, is admirably couched to court discussion and could not have been presented at a more critical time. It would aid the cause of water power development and legislation immensely if this discussion were taken up generally by engineers and those otherwise interested in the subject. The article by Mr. F. O. Broil discloses a point in the subject which will in all probability be of the utmost importance, namely, the attitude of the Government. The writer firmly believes that the Government is pursuing the policy of the "greatest good for the greatest number."

Having made the sad mistake of neglecting the forests until the major portion of them are beyond its control, and with such wholesale denudation of our watersheds ever increasing, the Government is making an effort to check the destruction of the natural reservoirs of our streams, i. e., the "mountain timber," which, better than any reservoir, gathers and holds the snows of winter and the rains of spring. The more timber contained on the watershed the more uniform the flow of the river and the greater its capacity during the low water season, which, in turn, increases the timber growth and valuation of the lowland products. With the disappearance of the timber comes the necessity of storage reservoirs—a more costly alternative.

While it is true that by the construction of storage reservoirs a great benefit is conferred upon others depending on the waters of the stream, cases frequently occur where the waters of a number of streams are impounded in a single system, the discharge from which is diverted from its regular channels, thus depriving some of its use in its natural beds. Unquestionably, the development of water power should be encouraged by the Government, for two principal reasons:

First—To save fuel and preserve the natural resources.

Second—To encourage a more even development of the country at large.

Toward this end the Government has spent millions of dollars in preparing exhaustive reports of available water powers of the Appalachian system, giving data on all watersheds, so that people who contemplate the utilization of water power may be informed as to the most valuable locations in which to invest capital. A report of the Western watersheds is being compiled, and can be had on application when complete. It would seem that no further pledge of sincerity is needed to show that the Government is trying to encourage water power developments.

There is, however, one point which needs careful attention, and that is the "monopolization of water rights." Just as sure as there are great timber combines, there are even now persons who are seizing the valuable water rights of this and other States, doing as little work as possible, and awaiting the natural development of the country to raise their value.

While this is a lawful proceeding, it is simply a water-right brokerage business, which is holding back the development of the country more than anything else. The writer does not know of a single instance where a company has planned a development with honest intentions to complete it, that has been discouraged by the Government unless there were good reasons to prove it was not for the "greatest good of the greater number."

There is no reason to suspect the Government of deliberately planning to cause loss to power companies as Mr. Broil intimates by revoking rights of way, and the writer knows of no case where this has been done so as to cause loss to the operating company. However, no Government official should have power to do this at his pleasure, but the operating company should be allowed to appeal its case to the Federal Court, otherwise the investor would neither receive justice nor financial support in hydro-electric development.

Mr. Broil's point as to permanent rights of way being granted to irrigation, ditches and reservoirs may be answered as follows:

Irrigation systems act as subsidiary streams furthering the improvement of the river and enlarging its scope in the surrounding country. Furthermore, it is impossible to change the grade of a ditch without crippling the whole system. Hence the permanent right of way. A pole line, however, may be changed without any considerable inconvenience.

Contrary to Mr. Broil's statement, generally speaking, a pole line does not cost as much as an irrigation ditch, especially referring to air line distance. Again, a power project may not help develop the adjacent country, but may distribute power in another district entirely, while a ditch but furthers the irrigation of the river basin. Incidentally, Mr. Broil's reference to a certain power company who were held up several years before they could procure a right of way for a pole line over Government land, recalls a similar case to the writer's mind (possibly

the same). The company was unable to procure a right of way for a proposed pole line for several years, and during the latter part of last year the project was finally financed and they then received the right of way. The surveys for this line originally crossed the canyon a number of times so that it would be hard for a competing company to run through the same canyon. While the right of way for the first company was pending, a second company who had sold their bonds applied for a permit through the same canyon and received it immediately. From this it would seem that if parties who contemplate water power developments co-operate with the Government, in the furthering of such projects, the development of undeveloped country would progress much more rapidly than at present.

To accomplish this end it is necessary to have the hearty co-operation of the engineering profession, and if their attitude on the subject be governed by a careful perusal of the "engineering code of ethics," there would be more developments of and less speculation in "water rights."

J. W. WHITE,

San Francisco, August 11.

Extract from Letter by F. G. Baum to Forester.

I have talked with many Forestry men, from Mr. Pinchot down, about water power, and practically not one of them mentions water power in two words, but in three—**water power monopoly.** Water power in California is **not** a monopoly, because **less than 10 per cent of the water power has been developed.** The Forest Supervisors report probably that most of the streams are located, and they **assume** that they are located by the power companies. Most of these locations are made by local people, and are held illegally because nothing is done to conform to law, and few people pay any attention to these locations. The people who make these paper locations are always trying to sell out to the power companies.

The solution is a change in local water laws.

To do an injustice to a bona fide proposition will help present monopolies, if there are any, although I do not know where there can be said to be a power **monopoly,** as the Forestry Department seems to fear.

The public in most of the Western cities can buy electric light for 10 cents per kilowatt hour, and in a great many cases for less. In the East the rate is very generally 50 per cent higher. Would it be a monopoly to sell a product at a certain price to people who want it and cannot get it in any other way for 50 per cent more?

I wish the Department would give the matter full and fair consideration, and to do that the side of the power man must be considered.

Dated August 1, 1908.

PERSONAL.

G. H. Schneider, of the Western Electric Company, has returned from a short trip to Los Angeles.

Russell A. Griffin, manager of the pole department of the Western Electric Company, is visiting San Francisco for a few weeks.

B. C. Holst, of the San Francisco telephone department of the Western Electric Company, has returned from a trip to Chicago.

Henry F. Frosch has returned to San Francisco from the East, and after a very successful business trip announces that Henry F. Frosch & Company will represent the Federal Electric Company, Excello Flaming Arc Lamp Company, General Incandescent Lamp Company, Minerallac Company, and Vulcan Electric Heating Company.

A. W. Vinson, for several years connected with the engineering department of the Cutler-Hammer Co., of Milwaukee, has arrived in San Francisco, where he will be located in the offices of Otis & Squires, Pacific Coast agents for the above mentioned company. His services there will be available to all encountering problems involving the use of any form of controlling apparatus.

OBITUARY.

JOHN CHURCH, for twelve years Western representative of the Electrical World, died July 30, 1908, of apoplexy at Chicago.

BOOKS RECEIVED.

Insomuch as the development of hydro-electric power offers such an attractive field to the capitalist desiring a permanent investment whose value tends to increase rather than decrease with time, a book dealing with the commercial side of the question should be welcomed. This field has been admirably filled by "Notes on Hydro-Electric Developments," by Preston Player. Starting with the necessary preliminary steps, the author follows the methods of procedure for engineering examination and determination of cost and economics as related to possible marketing of power developed. The treatment is analytical, and gives the details upon which to base capital costs for a typical installation. Engineers reporting upon water-power propositions will also find much of interest in this book. It contains seventy-three pages, and is sold for $1.00, by the McGraw Publishing Co., of New York City.

BUILDING A GREAT EDUCATIONAL INSTITUTION.

Among the modern builders of San Francisco is one who deserves as much credit for his indomitable pluck as any of the pioneers of older days. This is E. P. Heald, president of Heald's Business College. On April 18, 1906, every vestige of his colleges in San Francisco was swept away. Since that time there has been raised a monument to his memory that should live for all time in the history of San Francisco. The present abode of the home office of this great educational institution at 35 McAllister St. is a five story brick building containing class rooms for the business departments, and fully equipped laboratories and apparatus for all kinds of engineering work, including electrical, mining, civil and gas, as well as an automobile school. In it is that perfection of equipment united with the highest teaching talent that is preparing the young to meet the practical problems of life. Many of our best business men owe much of their success to the preliminary training, gained at Heald's Business College.

TRADE CATALOGUES.

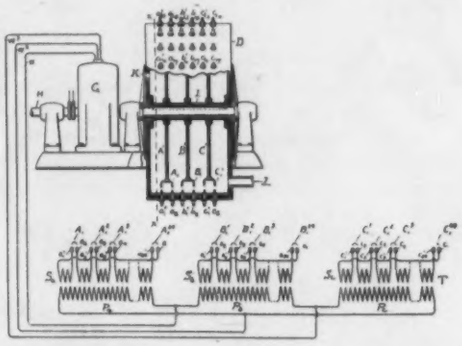
The demand for transformers suitable for underground installation is met by the General Electric Company, Schenectady, N. Y., in Bulletin No. 4608, just issued, which describes the improved Type H sub-way transformers.

PATENTS

PATENTS.

APPARATUS FOR MANUFACTURING NITROUS COMPOUNDS. 894,547. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company.

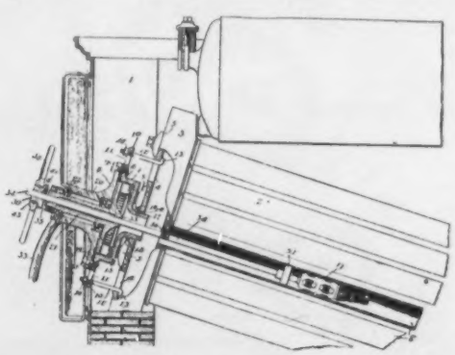
The combination of an air chamber and a number of independent circuits traversing the same, each having a



number of air gaps in series within the chamber, a low potential multi-phase current generator, a step-up transformer for inductively charging the chamber circuits with high potential by and in the order of the phases of the generator, and means for establishing, lengthening and breaking the electric arcs in the different series of air gaps in the order of succession of the phases of the generator, substantially as described.

APPARATUS FOR CLEANING BOILER TUBES. 894,557. Henry F. Weinland, Springfield, Ohio, assignor to The Lagonda Manufacturing Company, Springfield, Ohio.

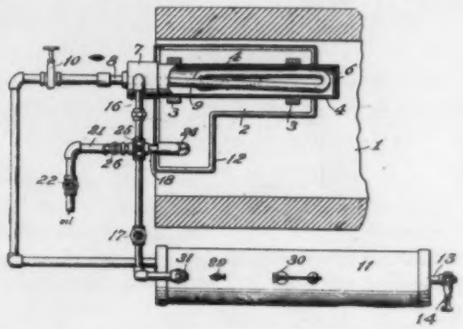
Apparatus for cleaning boiler tubes, comprising a motor having a hollow motor shaft and a rotating power-generating member or wheel mounted directly on said shaft, means for supporting said motor in variable fixed positions relatively to the boiler front, a cleaner shaft extending centrally through



the motor shaft, having a free longitudinal movement relatively thereto and rotating in unison therewith, a cleaning tool mounted on the forward end of said cleaner shaft, in front of the motor, and a feed-controlling handle mounted on the rear end of said shaft, in the rear of the motor, said cleaner shaft being free to rotate in said handle and moving longitudinally in unison therewith.

OIL-BURNING AND STEAM-GENERATING APPARATUS. 894,362. William N. Best and Benjamin F. Mears, Los Angeles, Cal.

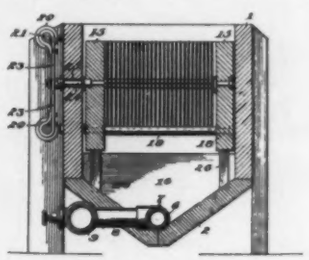
The combination with a combustion chamber of a water tank external thereto and having a valved water supply, a steam generator in the combustion chamber at a lower level than the water tank, a pipe connected to the lower part of the water tank, a coil connected to said pipe and extending within the generator, and opening at its end into the gener-



ator, a burner extending in the combustion chamber, a steam connection from the top of the generator to the burner and to the top of the water tank, said connection to the water tank being provided with a check valve to prevent steam pressure passing back from water tank to the generator, and an oil supply for the burner.

ELECTROLYTIC APPARATUS FOR PURIFYING LIQUIDS. 894,435. John T. Harris, New York, N. Y.

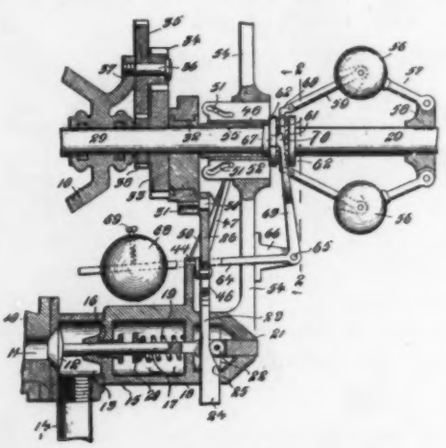
Apparatus for purifying water comprising a water-main,



a vessel, electrodes longitudinally disposed in said vessel and alternately of opposite polarity, said electrodes consisting of a metal or metals capable of yielding a colloidal hydroxid, and an inlet pipe connected with said water-main and extending beneath said electrodes and substantially parallel thereto.

GOVERNOR FOR TURBINES. 894,474. Abe C. Toms, Spokane, Wash.

In a governing mechanism, a reciprocating valve provided with a stem, an actuating bar having an inclined face to engage said stem and provided at one end with shoulders



disposed upon the opposite sides thereof, a slotted catcher arm having a bifurcated end engaging said bar and provided with oppositely disposed engaging portions to contact with said shoulders, and means disposed in the slot of said arm for laterally shifting said arm during the reciprocation thereof.

INDUSTRIAL

FIRE ENGINES UNNECESSARY WITH DIRECT HIGH PRESSURE SERVICE.

A test of the ten new motor-driven centrifugal pumps built by Allis-Chalmers Company, of Milwaukee, for the Manhattan high pressure fire service, demonstrated to the satisfaction of the New York Fire Department that the use of hydrants and hose, supplied with water at high pressure from the new central pumping stations, far exceeds in efficiency the best possible service obtainable from steam fire engines. This, too, despite the fact that the hydrants were only opened to half their capacity.

Twenty lines of huge rubber hose, three to each hydrant, and varying in length up to nearly an eighth of a mile, were trained on an imaginary conflagration, and each held in place by three firemen, with the assistance of mechanical supporters, although so steady was the pressure maintained that one man to each hose line would have sufficed. The importance of this, both from the standpoint of annual economy and the increased ability of the force to successfully fight large fires, should any such occur in future, will be at once appreciated.

When all was ready the fire valves in the mains were opened, the hydrants turned, and a single pump threw water at 300 pounds per square inch pressure into the waiting hose, other pumps being started in rapid rotation, until six were in service, forcing through the hydrants a volume of water that reached a total of 18,000 gallons per minute. Hydrometers attached to each feeding hydrant and nozzle indicated the strength of the stream.

In the first test water was turned on for twenty minutes and streams sent in an upward direction parallel to the skyscrapers in the vicinity. One of these, the Western Electric Building, is twelve stories high; but, at full pressure, water from several of the lines reached to its roof. At the end of the period mentioned, the supply of water was suddenly shut off; the nozzles were unclamped, and the lines "siamesed," *i. e.*, two lines run into a single hydrant mouth, ten of these extensions being made. The remainder of the flow was diverted to a water tower, and extension reared sixty feet in the air. When the signal was given, the plug indicators in a few minutes jumped to 300 pounds, while the greatest power at the nozzles was taken at 175 pounds on the two-inch pipes and 195 on the inch and a half. The water tower needle held at 175.

The lengths used in the test are the same as those which would be employed under actual fire conditions. The discharge was several times greater than would be used at even a very large fire. The arrangemnt of the high pressure system is such as to allow the engineers at the pumping station to concentrate or spread the supply of water and increase the pressure, within its maximum limit, at the command of the firemen. "This added power," said Chief Croker, after the test, "precludes the possibility of any large conflagration in this city. With a concentration of pressure such as we had today, we can control any blaze in a short time."

It was the general judgment of the authorities present that the day of the steam engine will soon be one of the past. The pumping stations and fire mains will eventually supplant them throughout the city. The disadvantages of the engine are every day becoming more manifest. The time lost in getting up steam, the minutes consumed in running to fires, the danger of blockades, and other delays, were all causes of the spread of conflagrations. With the required pressure almost instantly available at any point where fires break out the flames can be quickly brought under control, if not speedily extinguished, and a lowering of insurance rates in districts having this protection is only one of the natural consequences. That item alone will save the people of New York, and other cities installing the same system, an amount sufficient to cover both its first cost and annual maintenance many times over.

The new high pressure service of New York City is intended primarily to afford protection to what is known as the "Dry Goods District," extending north from the City Hall to Twenty-fifth Street, and east from North River to Second Avenue and East Broadway. There the buildings are "skyscrapers," and the need for high pressure to reach them is obvious. The system, as installed, comprises about 63 miles of extra heavy cast iron mains, from 12 to 24 inches in diameter, and two pumping stations with a present combined capacity of 30,000 gallons per minute, delivered at a pressure of 300 pounds per square inch.

The new system is known as the salt water system; it is, however, a fresh water system except in the emergency of the Croton supply running dry. The stations draw water from the Croton mains and pump it into the new high pressure mains as long as the supply lasts. If it fails, then the pumps will draw salt water from the rivers and pump this water into the high pressure mains. The change from one to the other can be made without a moment's delay. The high pressure system has special hydrants fitted to the special mains, which are entirely distinct from the present Croton water mains.

Both pumping stations are outside of the district of high fire risk, one being near the Gansevoort Market on the North River and the other on the corner of Olive and South Streets near the East River. The buildings are of brick and steel fireproof construction with concrete foundation. Each station contains five pumping units comprising Allis-Chalmers multi-stage centrifugal pumps each driven by an Allis-Chalmers 800-horsepower induction motor. The stations are identical in construction and equipment, and for the present each is laid out to accommodate eight pumping units, five of which are now installed. The pumps are of the horizontal multi-stage centrifugal type, each having six stages, delivering 3,000 gallons per minute against a discharge pressure of 300 pounds per square inch when operating at about 750 revolutions per minute, with a suction lift not exceeding 20 feet. The internal parts are all made of bronze composition; also the casing is lined with brass so that all parts in contact with water are non-corrosive.

Each pump is direct connected to its motor by a special flexible coupling designed to take care of any possible variation from perfect alignment. The motors are of the constant-speed induction type, 3-phase, 25-cycle, 6,300 to 6,600-volt, 800 horsepower, designed to operate at about 750 revolutions per minute. Their full load efficiency is approximately 93 per cent; the full load power factor is approximately 94 per cent, and the slip at full load is approximately 1 per cent. The motors are of the wound rotary type, and in starting an iron grid resistance is connected in the secondary circuit and gradually cut out by means of a hand wheel installed on the motor switchboard panel. When the resistance is all cut out the rotor is automatically short circuited by means of specially constructed solenoids, which are controlled and operated by means of a small control switch mounted directly on the shaft of the hand wheel above referred to. These controllers and motors are so designed that they can be brought up from a standstill to full speed in approximately 30 seconds. An interlocking arrangement is provided with the controller device, arranged in such a manner that the operator cannot close the switch connecting the motor to the line while the rotor is short circuited. Each combined unit is equipped with automatic and hand control. The pumps can

be kept primed constantly ready for almost instantaneous service and by means of pressure regulators and relief valves, the discharge can be maintained at any desired pressure between 100 and 300 pounds per square inch.

The current for operating both of these stations is to be supplied by the New York Edison Company. This company has six generating and distributing stations in the city. Each station has special 3-phase cables laid in ducts running from the main generating station. There are always hydrants within 400 feet of any building in the district, and there are enough hydrants so that 60 streams of 500 gallons per minute can be concentrated on a block with a length of hose not exceeding 400 to 500 feet. To save time in sending in orders to the engineer at the stations concerning the pressure and amount of water required, a system of telephone boxes is being installed, so placed that a fire in any part of the district can be watched from at least one of these signal stations.

In order that there may be no delay occasioned by priming the pumps when they are to handle salt water, three vacuum pumps are provided, each of which, when working singly, can prime the suctions and maintain constantly for the eight pumps a vacuum of at least 26 inches of mercury. Two of these pumps are of the self-oiling, two-cylinder, single-acting type, having a piston displacement of about 50 feet each, when working at a piston speed of 160 feet per minute. Each is geared to a direct-current motor, the unit in each case being self-contained. The third pump has a displacement of 300 feet per minute, working at a piston speed of 300 feet, and has mechanically-controlled intake valves. This, too, is self-contained with its motor.

Connected to the highest point of each salt water suction line is a cylindrical air chamber, with a capacity of about 130 cubic feet, in which the entrained air and gases in the water will be collected so that the suction to the main pumps can be maintained at all times. Each air chamber is equipped with a gauge glass and vacuum gauge. The priming apparatus is so designed that any one or all three of the air pumps can be operated in connection with either of the air chambers. By an automatic device one of the smaller pumps will be set in motion when the water in the air chamber falls below a predetermined level; similarly, the large vacuum pump will be put in operation automatically when the water falls below a second predetermined level, indicating that the smaller pump cannot maintain the required vacuum. The second small vacuum pump will be held in reserve for use in special emergencies. The main pumps can also be primed with fresh water taken from the city water distribution system through the 12-inch pipe shown on the accompanying plan.

The fresh water supply for the Gansevoort station is taken from a number of large mains of the city water supply system varying in size from 20 to 48 inches, cross-connected by a 36-inch main from which two 24-inch suction lines extend longitudinally under the pumps at each side of the building. These pipes are cross-connected at each end of the basement with a 20-inch pipe equipped with a motor-operated gate valve. A 24-inch motor-operated gate valve is placed just outside the suction loop on each of the five supply pipes and 24-inch manually operated gate valves are arranged on both suction and discharge mains as shown on the plan. The 24-inch discharge main forms a loop, the ends of which leave the building at the north end, where a 24-inch motor operated valve and a Venturi meter with a recording instrument are introduced in each line.

The suction end of each pump is connected to the suction main by a 24-inch pipe which gradually reduces to 10-inch at the pump, where a 10-inch gate valve is introduced. Each pump discharges through a 10-inch check valve and a 10-inch motor-operated gate valve into a pipe which increases to 20-inch at its connection with the main discharge West-street station line. The valves are introduced to facilitate the isolation of the pumps from the system and prevent back flow from the delivery pipe into the suction main. Tees are provided in the pump suction and delivery pipes to connect with the station by-pass.

The mains are designed to withstand a regular working pressure of 300 pounds per square inch, and are very heavy. The joints are of special form, and there are deep double grooves in both the spigot and the hub ends. The special castings for the large three-way and four-way branches are made of steel with a very large factor of safety. The other specials are cast-iron and are also designed with a large factor of safety. The gates are of cast iron and have nickel steel stems which combine great strength with freedom from corrosion. All other working and bearing parts are of bronze composition. All gates, 12-inch and larger, are fitted with by-passes to relieve pressure on the disc, and all gates have flange ends with a short spigot piece bolted to the gate so that in case of a break the gate can be removed and a new gate substituted very quickly.

The New York high-pressure system was designed by Mr. I. M. de Varona, Am. Soc. C. E., chief engineer of the department of water supply, gas and electricity, who also designed the high-pressure fire system for Brooklyn and Coney Island, and under whose supervision the construction work is carried on. Mr. Thomas J. Gannon, engineer in charge of the mechanical division, has had charge of the preparation of plans and specifications for the pumping machinery, electrical motors and appliances. Mr. Henry B. Machen, Assoc. M. Am. Soc. C. E., assistant engineer, has direct charge of the contracts for furnishing, delivering and laying the distribution mains. Mr. John P. Reynolds, Jr., Jun. M. Am. Soc. M. E., mechanical engineer, has superintended the construction of the pumping stations and the salt water suction intakes. The complete equipment of the pumping stations, including both the multi-stage centrifugal pumps and the induction motors operating them, was built and installed by Allis-Chalmers Company, of Milwaukee.

HOLOPHANE CONVENTION.

The fourth annual convention of sales, engineering and manufacturing departments, Holophane Company, was held at Hotel Sagamore, Lake George, July 12th to the 18th. The party, consisting of some forty salesmen, department heads and executive officers, in addition to whom were the wives of half dozen of the men and several invited guests, made a party of over fifty. Conferences on matters of business and policy occupied the mornings, the men engaging in sports and pleasure jaunts in the afternoons. A number of very important matters were discussed, and plans adopted which will greatly enlarge the scope of the Holophane Company's work in future. Announcements of these changes will be made shortly.

GENERAL ELECTRIC NEW ORDERS.

The General Electric Company announces that the following orders for new apparatus have been recently received: Isthmian Canal Commission: Six vertical Curtis turbine units, 1500 kilowatts, 25-cycle, 2200-volt, each complete with individual base condenser, air and circulating pumps and necessary piping. Electrical equipment for one 20-ton traveling crane. Four 35-kilowatt 125-volt direct-current turbine-driven exciters. Four 500-kilowatt 600-volt rotary converters, each complete with three air-blast type transformers. Six 100-kilowatt, 2200-6600-volt, single-phase, oil-cooled transformers. Six 110-kilowatt, air-blast type transformers. Two switchboard equipments.

Mitsui & Co., Japan: Fifty GE-52 railway motor equipments, also rotary converters, transformers, etc. Twenty GE-52 double motor equipments, with headlights and spare parts. Three 1000-kilowatt alternating current generators.

Australian G. E. Co.: Seventy 4-motor type, M control equipments for GE-81 railway motors.

Santos Dock Co., Brazil: Six 3000-kilowatt transformers and five 50-light constant current transformers. One motor generator set. 628 arc lamps. One switchboard. Miscellaneous small motors and transformers.

Pueblo Tramway Light & Power Co., Mexico: Ten water-cooled, 1500-kilowatt, 60-cycle transformers.

NEWS NOTES

WATERWORKS.

Quincy, Cal.—It is given out by the Goodwin estate that the local water system is to be enlarged and improved.

Martinez, Cal.—About $12,000 is to be expended by the Associated Oil Company for a new water system at Port Costa.

Phoenix, Ariz.—About 7000 feet of pipe will be needed before the waterworks system here can pipe water into the houses.

Sierra Madre, Cal.—The stockholders of the local water company are considering the replacing of about 5000 feet of mains at a cost of about $1800.

Highland, Cal.—The City Creek Water Company will expend about $1000 for 10-inch vitrified pipe for the purpose of securing a greater water supply.

Sacramento, Cal.—Chief Engineer Wulff of the municipal waterworks has reported to the mayor that a new pumping plant is needed for the station.

Glendora, Cal.—The stockholders of the Glendora-Azusa Water Company have decided to dig a new well, install another pumping plant, and lay a new main.

Flagstaff, Ariz.—Government engineers are reported to be hunting for reservoir sites on the Indian reservations with a view to irrigating the lands allotted to the Indians.

San Rafael, Cal.—The trustees have decided to enlarge the salt water plant for street sprinkling and sewer purposes by extending the mains to the western section of the city.

Woodland, Cal.—The Fire and Water Committee of the Board of Trustees has been instructed to make inquiry as to the cost of installing an auxiliary pumping plant with seventy-five horsepower motor as a driving power.

Alameda, Cal.—Alex. Mackie has submitted plans to the Alameda Improvement Association, showing that a salt-water plant for this city would cost about $200,000, and that the present municipal power plant could furnish the necessary power for the operation of the new plant.

Salt Lake, Utah.—Sealed bids will be received till September 1st for furnishing 17,000 feet of wooden pipe from eight to fourteen inches in diameter, 14,000 feet of steel pipe eight to twelve inches in diameter, seven gate and air valves, and 150,000 feet of timber for flumes and trestles.

Corning.—D. H. Adkins, J. A. Whipple, N. D. Rice, and H. A. Harper have associated themselves for the purpose of constructing a water plant for the use of residents in their section of the town. The plant is to consist of a 10-inch bored well, over which is to be a 10,000 gallon tank. The power is to be a 5-horsepower motor. The location for the plant was donated by W. M. Woodson.

ILLUMINATION.

San Diego, Cal.—Ayres & Stevenson will begin the manufacture of gas and electric fixtures at 627 Seventh Street in this city in the near future.

Carlsbad, N. M.—The Public Utilities Company of this place is preparing to extend its electric light and power lines through the suburban district of Otis.

Phoenix, Ariz.—The City Council is considering the matter of letting a contract to the Mesa Light & Power Co. for supplying the town with light for two years.

Richmond, Cal.—It is given out by City Attorney Hart that a San Francisco syndicate is preparing to submit to the city authorities a proposition for establishing gas works in Richmond.

Elsinore, Cal.—The Town Trustees and the local electric light company have come to an understanding by means of which the lighting company will put in wires and light the business streets of the city.

Globe, Ariz.—N. L. Amster, of Boston, who has acquired the interest of N. C. Cottee and David James in the Globe Electric Light & Gas Company, now owns three-fourths of the capital stock of the company.

Lompoc, Cal.—A. Ganslein, a representative of Los Angeles parties, was here a few days ago taking preliminary steps toward establishing a plant for the manufacture of gas for illuminating and fuel purposes.

San Francisco.—The Board of Public Works has invited bids for the construction of a 200,000-gallon water tank on the Almshouse tract for the Relief Home. The cost will be defrayed from the $10,000 appropriation for grading the site of the new infirmary.

Modesto.—The Supervisors of Stanislaus County, Cal., have accepted the bid of the La Grange Mining and Power Company for a franchise for the construction and maintenance of lines for electric light and power over the roads of the county in the district between the Tuolumne, Stanislaus and Merced Rivers.

TELEPHONE AND TELEGRAPH.

Redlands, Cal.—The Consolidated Telephone Company has decided to build this fall a line from Redlands to El Paso, a distance of 750 miles, thus connecting Los Angeles with El Paso.

San Francisco.—The judiciary and public utilities committee of the Board of Supervisors has decided not to take up the question of the validity of the franchise of the Home Telephone Company in this city.